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EXAMINER

KIELIN, ERIK J

ART UNIT

PAPER NUMBER

2813

DATE MAILED: 11/01/2002

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/961,036

Applicant(s)

DATTA ET AL

Examiner

Erik Kielin

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03 October 2002.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 17-45 is/are pending in the application.
- 4a) Of the above claim(s) 20,22,24 and 26-45 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 17-19,21,23 and 25 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 21 September 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2. 6) ☐ Other: _____

DETAILED ACTION

1. This amendment is in response to the election filed 3 October 2002.

Response to Amendment

2. Applicant's amendment to claim 17 changes the nature of the species indicated in the restriction requirement, since the claim was amended to change the first and third metal layers to be the same material as well as the second and fourth layers to be the same material -- as opposed to having the first, third, and fourth layers be the same material.

Examiner also notes, in this regard, that Applicant has stated that support for having the first, third, and fourth layers be the same material is supported in "throughout the specification." (See section entitled "REMARKS," Paper No. 6, filed 3 October 2002, p. 2, second paragraph.) Examiner can find no such support and requests further clarification from Applicant to instruct Examiner where such support exists. Rather the specification only appears to provide support for the limitations in claim 17 as presently amended (as opposed to as originally filed): that the first and third material layers are the same and the second and fourth material layers are the same. (See especially instant Fig. 5.)

Election/Restrictions

3. Applicant's election with traverse of the species of Group I, claims 17-19, 21, 23, and 25 in Paper No. 6 is acknowledged. The traversal is on the ground(s) that "the Office action failed to demonstrate proper grounds for restriction" presumably because "independence of inventions" and "serious burden of search" has not been demonstrated. This is not found persuasive because

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Applicant is mistakenly attempting to apply the reasons for restriction according of different inventions to that for plural species. See 37 CFR 1.142 and more particularly 37 CFR 1.146 which states,

In the first action on an application containing a generic claim to a generic invention (genus) and claims to more than one patentably distinct species embraced thereby, the examiner may require the applicant in the reply to that action to elect a species of his or her invention to which his or her claim will be restricted if no claim to the genus is found to be allowable. However, if such application contains claims directed to more than a reasonable number of species, the examiner may require restriction of the claims to not more than a reasonable number of species before taking further action in the application. [43 FR 20465, May 11, 1978; revised, 62 FR 53131, Oct. 10, 1997, effective Dec. 1, 1997]

Nonetheless, in light of Applicant's allegation that independence of inventions has not been properly demonstrated, and that there is not undue burden of search and examination of the plurality of species presently disclosed and claimed, Examiner will kindly address these issues.

Evidence of independence of inventions is provided by Applicant's admissions from the specification (as will be noted below) and by Applicant's failure to clearly admit on the record that the disclosed embodiments are obvious variations as required by the Office action making the restriction requirement, filed 27 August 2002, which states in pertinent part,

"Should applicant traverse on the ground that the species are not patentably distinct, **applicant should submit evidence or identify such evidence now of record showing the species to be obvious variants or clearly admit on the record that this is the case.** In either instance, if the examiner finds one of the inventions unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other invention." (Emphasis added.)

Because Applicant has not so done, this provides evidence that Applicant agrees that the species are patentably distinct.

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Applicant is further directed to the instant specification wherein Applicant has specifically indicated numerous embodiments for which Examiner asserts is in accordance with 37 CFR 1.146 that the plurality of species meets the condition for “more than a reasonable number of species.”

Applicant's specification states at pp. 4-5, the choice of metal for the first metal layer may be Ti, Zr, Hf, “and the like,” Ni, Co, Pd, Pt, “and the like,” Cr, Mo, W, “and the like,” Sc, Y, La, Ce, “and the like.” The specification continues, “in one embodiment, the metal first layer 26 is titanium that is formed by physical vapor deposition (PVD) to a thickness in a range from about 500 Å to about 2000 Å...” The specification further continues, “In another embodiment the metal first layer 26 is chromium that is formed by physical vapor deposition (PVD) to a thickness in a range from about 500 Å to about 2000 Å...” So for the first (and third, as required by claim 17) metal layer alone, Applicant has presented 14 different metals.

For the second metal layer (and as required by claim 17, the fourth metal layer), according to the specification, “may be preferably a refractory metal, a refractory metal alloy, or a doped refractory metal. The specification continues, “In one embodiment metal second layer 28 is vanadium-alloyed or vanadium-doped metal of at least one metal selected from nickel, cobalt, palladium, platinum, or the like.” The specification continues that the metal second layer may be ferroelectric, or other vanadium-doped or -alloyed, with Ti, Zr, Hf, Cr, Mo, W, Sc, Y, La, Ce, “and the like.” Again 14 different alloys are indicated.

Given 14 metals for the first and third layers and 14 metals, doped metals or metal-alloys for the second and fourth metal layers, not to mention any refractory metal, refractory metal alloy, or doped refractory metal, gives 14 times 17 or 238 different combinations.

But these are not the only embodiments disclosed. Applicant's specification indicates that other embodiments include the method by which the each of the four metal layers is deposited and the thicknesses of each of the four metal layers, both in angstroms and "arbitrary units." (See specification, p. 5, lines 6-10; p. 6, lines 1-4; paragraph bridging pp. 6-7.

The specification also indicates that alternative embodiments include nitriding either the second and/or the fourth metal layers. (See specification p. 7, lines 5-11.)

Other embodiments indicate that the metal bump is deposited by electroplating and by electroless plating. (See paragraph bridging pp. 7-8.) Additional embodiments in regard to the bump include the composition of the bump. (See p. 8, lines 8-12.)

Yet additional embodiments, as indicated by Applicant, include the means by which the bump and the four metal layers are patterned and the geometry of the bump. (See Figs. 8A-8C, and 9 and associated text at pp. 8-10.)

While this is not all of the embodiments disclosed in the instant specification, given the possible combinations, thus far, of the different metals and alloys of the four metal layers (238), the method of deposition of each layer (4), the thickness of each layer (≥ 4), the state of nitridation of the 2nd and/or 4th metal layers (3), the method of applying the bump electrode (2), and the method of patterning the metal layers (≥ 3), gives $238 \cdot 4 \cdot 4 \cdot 3 \cdot 2 \cdot 3 = 68,544$. Accordingly, there are at least 68,544 combinations. Examiner asserts this is sufficient to indicate serious burden of search.

The requirement is still deemed proper and is therefore made FINAL.

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4. Claims 20, 22, 24, and 26-45 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected species, there being no allowable generic or linking claim.

Drawings

5. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the limitations of claim 18 --more specifically, the connection of the copper pad contacting a metallization in a range from M1 to M6-- must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

6. The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required: the limitations of claim 18 do not appear in the specification.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 17, 19, 21, 23, and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 5,376,584 (**Agarwala et al.**) in view of US 6,348,730 B1 (**Yi et al.**).

Agarwala discloses a process of forming a ball limiting metallurgy (BLM) comprising, forming a metallization (layer shown beneath that layer labeled “20” in Fig. 3, but not labeled, to which the BLM layers 22, 24, and 26 electrically connect);

forming phased metal layer 24 using physical vapor deposition, which comprises two metals including a first metal of Cr, Ti, Zr, Mo, Ta or any other metal or alloy which will adhere to the surface of the metallization and a second metal including Cu, Co, Ni, Pt, and Pd (paragraph bridging cols. 3-4); and

forming a conductive bump 28, Figs. 4-6 above the phased metal layer 24.

Agarwala does not indicate the nature of a phased metal layer, or more specifically that the phased metal layer includes a first and third layers of substantially the same metal and the second and fourth metals are of substantially the same metal.

Yi discloses a BLM and method of making, having a phased metal layer 53 (Figs. 8-9, plurality of 151 and 155) formed by physical vapor deposition (e.g. sputtering; col. 3, lines 39-44), wherein the first and third metals are the same (Cr in one example) and second and fourth metal layers are the same (Cu in one example). (See also col. 3, lines 7-14; col. 4, lines 32-49.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention, to form the phased metal layer of **Agarwala** using the method of **Yi** wherein the metal

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composition alternates between the different metals, in order to achieve the benefits indicated in **Yi**, such as achieving the desired thickness of the metal layers (col. 2, lines 59-63); and speeding up the process and reducing the cost of making the metal layers (col. 2, lines 64-67).

9. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Agarwala** in view of **Yi** as applied to claim 17 above, and further in view of Microelectronics Packaging Handbook, Semiconductor Packaging, Part II, 2nd edition, Tummala, et al. eds., Kluwer Academic Publishers: Boston, 1997, pp. 132-139 (**Handbook**, hereafter).

The prior art of **Agarwala** in view of **Yi**, as explained above, discloses each of the claimed features except for indicating that the metallization contains one of M1 to M6 connected to a copper bonding pad metallization.

The **Handbook** teaches that it is notoriously well known (1) for the bonding pad to be copper (p. 137, last paragraph, and Fig. 8-6 on p. 138), as well as (2) for the bond pad to attach to one of the metallization layers (the third metallization layer as shown in Fig. 8-2, on p. 133).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to ensure that the BLM of **Agarwala** connects to a copper bond pad because copper bond pads are notoriously well known in the art, as taught in the **Handbook**, and for the bond pad to connect to one of the metallization layers, in order to make an electrical connection to the devices in the semiconductor chip, as is essential for providing power, signal input/out, etcetera, as taught by the **Handbook**.

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Conclusion

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US 6,111,321 (**Agarwala**) teaches a similar BLM as that discussed above.

JP 2001-189334 (**Yi et al.**) is the Japanese priority document of the US patent applied above.

US 4,290,079 and US 4,360,142 (each to **Carpenter et al.**) teach a BLM comprising first and third metal layers of Cu-Cr and second and fourth metal layers of Cu. (See Figs. 1 and 2.)

IBM TDB NN77081005 teaches phasing wherein the first and third and second and fourth layers are the same metal.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.



Erik Kielin

October 31, 2002